

Glossary





Atom. The basic component of all matter. The atom is the smallest particle of an element that has all of the chemical properties of that element. Atoms consist of a nucleus of protons and neutrons surrounded by electrons.

Canyon. A vernacular term for a chemical separations plant, inspired by the plant's long, high, narrow structure (e.g., F and H Canyons at the Savannah River Site). Not all chemical separations plants are canyons.

Cesium. An element chemically similar to sodium and potassium. The isotope cesium-137 is one of the most important fission products with a half-life of about 30 years.

Chemical separation. A process for extracting uranium, plutonium, and other radionuclides from dissolved spent nuclear fuel and irradiated targets. The fission products that are left behind are high-level waste. Chemical separation is also known as reprocessing.

Cladding. The outer layer of metal over the fissile material of a nuclear fuel element. Cladding on the Department's spent nuclear fuel is usually aluminum, zirconium, or stainless steel.

Cold War. A conflict over ideological differences between the United States and the Soviet Union and their allies lasting from the late 1940's until the early 1990's and carried on by methods short of sustained military action.

Cost Avoidance. A cost that is not in the budget base but that was projected to have been required at some point in the future if the action to avoid the cost had not taken place. There are no resources which can be applied for other purposes in the budget.

Cost Saving. An actual reduction in an amount that is in the budget base from prior years. In the budget year, this typically means that the actual resources saved can be moved and used for other purposes.

Criticality. A term describing the conditions necessary for a sustained nuclear chain reaction.

Curie. The amount of radioactivity in 1 gram of the isotope radium-226. One curie is 37 billion radioactive disintegrations per second.

Deactivation. Activities that ensure surplus facilities are secure in a safe and stable condition pending their ultimate disposition. Includes eliminating immediate safety and environmental hazards as well as removing most contaminants within the facility.

Decommissioning. Retirement of a nuclear facility, including decontamination and/or dismantlement.

Decontamination. Removal of unwanted radioactive or hazardous contamination by a chemical or mechanical process.

Department of Energy (DOE). The cabinet-level U.S. Government agency responsible for nuclear weapons production and energy research and the cleanup of hazardous and radioactive waste at its sites. It succeeded predecessor agencies, such as the Energy Research and Development Administration and the Atomic Energy Commission.

Depleted uranium. Uranium that, through the process of enrichment, has been stripped of most of the uranium-235 it once contained, so that it has more uranium-238 than natural uranium. It is used in some parts of nuclear weapons as a raw material for plutonium production, as a shielding material, and in other applications.

Detection level. The level above which a constituent (e.g., metal, organic) can be detected in a medium through sampling and analysis.

Disposition. Reuse, recycling, sale, transfer, storage, treatment, consumption, or disposal.

DOE Complex. The research, development, and production facilities overseen by U.S. Department of Energy Headquarters and Field Office personnel.

Enrichment. See isotope separation.

Excess materials. Nuclear materials not needed to support national security requirements; only Pu-239 and highly enriched uranium formally have been declared excess.

Fissile. Capable of being split by a low-energy neutron. The most common fissile isotopes are uranium-235 and plutonium-239.

Fission. The splitting or breaking apart of the nucleus of a heavy atom usually caused by the absorption of a neutron. Large amounts of energy and one or more neutrons are released when an atom fissions.

Fuel, nuclear. Fissile material, usually natural or enriched uranium that sustains the fission chain reaction in a nuclear reactor. Also refers to the entire fuel element, including structural materials and cladding. Also known as reactor fuel.

Fuel and target fabrication. Foundry, preparation, and machining operations required to convert uranium or other fissile feed material into nuclear fuel elements; or precursor isotopes into target elements for the production of other isotopes.

Gamma radiation. High-energy, highly penetrating electromagnetic radiation emitted in the radioactive decay of many radionuclides. Gamma rays are similar to X-rays.

Gas centrifuge. A uranium enrichment process that uses a large number of rotating cylinders in a series. The lighter uranium-235 isotope concentrates at the center of a spinning centrifuge of gaseous uranium hexafluoride. This method produced the first gram quantities of enriched uranium in 1944.

Gaseous diffusion. A uranium enrichment process based on the difference in rates at which uranium isotopes in the form of gaseous uranium hexafluoride diffuse through a porous barrier. This process is used to enrich uranium in the United States. The full scale K-25 gaseous diffusion plant was completed and operational at Oak Ridge, Tennessee, in August 1945. Two additional, currently operating, gaseous diffusion plants previously used by the Atomic Energy Commission and Department of Energy for weapons production are located at Paducah, Kentucky and Piketon, Ohio.



Geologic repository. A place to dispose of radioactive waste deep beneath the earth's surface.

Half-life. Half-life is the amount of time needed for half of the atoms of a radioactive material to disintegrate or decay.

Hazardous waste. Defined under the Resource Recovery and Conservation Act (RCRA) and its implementing regulations in Title 40 of the Code of Federal Regulations, Parts 260 to 279, and corresponding state regulations. A material is a hazardous waste under RCRA if it meets the definition of a solid waste as well as certain criteria for a hazardous characteristic or listing.

High-level waste. Highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations. High-level waste includes other highly radioactive materials that the NRC, consistent with existing law, determines by rule requires permanent isolation.

Highly-enriched uranium. Uranium with more than 20 percent of the uranium-235 isotope, used for making nuclear weapons and also as fuel for some isotope-production, research, and power reactors. Weapons-capable uranium is a subset of this group.

Irradiate. To expose to ionizing radiation, usually in a nuclear reactor. Targets are irradiated to produce isotopes.

Isotope separation (enrichment). The process of separating different isotopes of the same element. The three elements that have been isotopically enriched in large quantities for use in nuclear weapons production are uranium, lithium, and hydrogen.

Isotopes. Forms of the same chemical element that differ only by the number of neutrons in their nucleus. Most elements have more than one naturally occurring isotope. Many more isotopes have been produced in nuclear reactors and accelerators.

Low-enriched uranium. Uranium that has been enriched until it consists of up to 20 percent uranium-235 and 80 percent uranium-238. It is used as nuclear reactor fuel, which is generally manufactured at below five percent uranium-235.

Low-level waste. Any radioactive waste that is not spent fuel, high-level or transuranic waste, or IIe (2) byproduct material (tailings/waste from uranium ore processing).

National Environmental Policy Act. A Federal law, enacted in 1970, that requires the Federal Government to consider the environmental impacts of, and alternatives to, major proposed actions in its decision-making processes.

Natural uranium. Uranium that has not been through the enrichment process. It is made of 99.3 percent uranium-238 and 0.7 percent uranium-235.

Naval Nuclear Propulsion Program. A joint Department of Energy and Department of Navy program responsible for activities relating to the use of nuclear power in surface warships and submarines.

Neutron. A massive, uncharged particle that comprises part of an atomic nucleus. Uranium and plutonium atoms fission when they absorb neutrons. The chain reactions that make nuclear reactors and weapons work thus depend on neutrons. Manmade elements can be manufactured by bombarding other elements with neutrons in production reactors.

Nuclear Materials Council (NMC). The NMC is chaired by the Under Secretary and is made up of members from the Secretarial Offices that have nuclear materials management responsibilities. The NMC establishes policy, provides personnel and financial resources, approves NEPA compliance and public involvement strategies, approves (or recommends approval of) Stewardship Task Force (STF) deliverables, and oversees STF activities.

Nuclear reactor. A device that sustains a controlled nuclear fission chain reaction.

Nuclear Regulatory Commission (NRC). An independent agency of the Federal Government created by the Energy Reorganization Act of 1974, which abolished the Atomic Energy Commission and transferred its regulatory function to the NRC. The agency is responsible for ensuring adequate protection of public health and safety, the common defense and security, and the environment in the use of nuclear materials in the United States. It is also responsible for regulation of commercial nuclear power reactors; non-power research, test, and training reactors; fuel cycle facilities; medical, academic, and industrial uses of nuclear materials; and the transport, storage, and disposal of nuclear materials as waste.

Nuclear Waste Policy Act of 1982 (Public Law 97-425), as amended. The Federal law that provides for the development of geologic repositories for disposal of high-level waste and spent nuclear fuel and establishes a program of research, development, and demonstration regarding disposal of high-level waste and spent nuclear fuel.

Nuclear weapons complex. The chain of foundries, uranium enrichment plants, nuclear reactors, chemical separation plants, factories, laboratories, assembly plants, and test sites that produce nuclear weapons.

Pit. The central core of the primary stage of a nuclear weapon consisting of fissile materials surrounded by the tamper and sometimes by a sealed metal shell.

Plutonium (Pu). A manmade fissile element. Pure plutonium is a silvery metal heavier than lead. Material rich in the plutonium-239 isotope is preferred for manufacturing nuclear weapons. The half-life of plutonium-239 is 24,000 years.

Plutonium residues. Materials left over from the processing of plutonium that contain enough plutonium to have previously made its recovery economically attractive when the United States was producing plutonium for weapons purposes. As excess materials, some plutonium residues could be disposed of directly as wastes.

Production reactor. A nuclear reactor designed to produce manmade isotopes. Tritium and plutonium are made in



production reactors. The Department has 14 such reactors, 9 at the Hanford Site and 5 at the Savannah River Site. All have been closed.

PUREX. An acronym for plutonium-uranium extraction, the name of a chemical process used to reprocess spent nuclear fuel and irradiated targets. Also refers to the chemical separation plants at the Hanford Site and Savannah River built to use this process. The PUREX Plants operated from 1957 to 1972 and from 1983 to 1988.

Radiation. Energy transferred through space or other media in the form of particles or waves. Certain radiation types are capable of breaking up atoms or molecules. The splitting, or decay, of unstable atoms emits ionizing radiation.

Radioactive. Of, caused by, or exhibiting radioactivity.

Radioactivity. The spontaneous emission of radiation from the nucleus of an atom. Radionuclides lose particles and energy through the process of radioactive decay.

Radionuclide. A radioactive species of an atom. For example, tritium and strontium-90 are radionuclides of elements of hydrogen and strontium, respectively.

Reactor fuel. Synonymous with nuclear fuel.

Reactor operations. Includes fuel and target loading and removal, reactor maintenance, and operation of the reactor itself.

Reprocessing. Synonymous with chemical separation.

Resource Conservation and Recovery Act (RCRA). (Public Law 94-580). A Federal law enacted in 1976 to address the treatment, storage, and disposal of hazardous waste.

Research reactor. A class of nuclear reactors used to do research into nuclear physics, reactor materials and design, and nuclear medicine. Some research reactors also produce isotopes for industrial and medical use.

Sealed source. A small package of radioactive materials used as a portable source of radiation packaged to minimize the possibility of dispersion of its radioactive contents.

Source material. Uranium or thorium in any physical or chemical form, and ores containing at least 0.05 percent uranium or thorium. Source material does not include special nuclear material or byproduct material.

Special nuclear material (SNM). Defined under the Atomic Energy Act as plutonium, uranium-233, and uranium enriched in the isotopes uranium-233 or uranium-235. Special nuclear material does not include source material such as natural uranium or thorium.

Spent nuclear fuel. Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.

Stabilization. Conversion of chemically active or readily dispersible matter into an inert or less harmful form. Also, activities to reduce the active management required for surplus facilities (such as burial ground stabilization and closure).

Stewardship Task Force (STF). The Nuclear Materials Stewardship Initiative effort is being carried out by an STF chaired by the Director of the Office of Nuclear Materials Management Policy and consists of a senior management-level appointee from each of the Department's programs with a nuclear materials management responsibility. The role of the STF is to establish and implement nuclear materials management policies and goals through specific working groups comprising program, field, laboratory, and contractor representatives, as needed.

Surplus materials. Nuclear materials that are not required for any Department need.

Target. Material placed in a nuclear reactor to be bombarded with neutrons in order to produce isotopes that do not occur naturally in significant quantities. Uranium-238 targets are used to make plutonium; lithium targets are used to make tritium.

Transuranic waste. Waste contaminated with uranium-233 or transuranic elements having half-lives of over 20 years in concentrations more than 1 ten-millionth of a curie per gram of waste.

Tritium. The heaviest isotope of the element hydrogen. Tritium is produced in nuclear reactors and is three times heavier than ordinary hydrogen. Tritium gas is used to boost the explosive power of most modern nuclear weapons. Tritium has a half-life of approximately 12 years.

Uranium. The basic material for nuclear technology. This element is naturally slightly radioactive and can be refined from its ore to a heavy metal more dense than lead.

Uranium hexafluoride (UF₆). A gaseous form of uranium used in the gaseous diffusion enrichment process.

Uranium-233 (²³³U). A man-made fissile isotope of uranium.

Uranium-235 (²³⁵U). The lighter of the two main isotopes of uranium; it is the only naturally occurring fissile element. Uranium-235 makes up 0.7 percent of the uranium that is mined from the ground. It has a half-life of 704 million years.

Uranium-238 (²³⁸U). The heavier of the two main isotopes of uranium. Uranium-238 makes up over 99 percent of uranium that is mined from the ground. It has a half-life of 4.5 billion years and is not easily split by neutrons.

Vitrification. A process that stabilizes nuclear waste by mixing it with molten glass. The glass mixture is poured into cylindrical metal canisters, where it hardens. Plants for vitrifying high-level waste have been built in the United States at West Valley, New York and the Savannah River Site, South Carolina.

Waste. Includes high-level, transuranic, low-level, mixed low-level, and IIe (2) byproduct material.

Weapons-capable materials. Materials that are capable of use in a nuclear weapon (e.g., plutonium that contains at least 93 percent of plutonium-239 by mass, and highly enriched uranium that contains at least 20 percent of uranium-235).